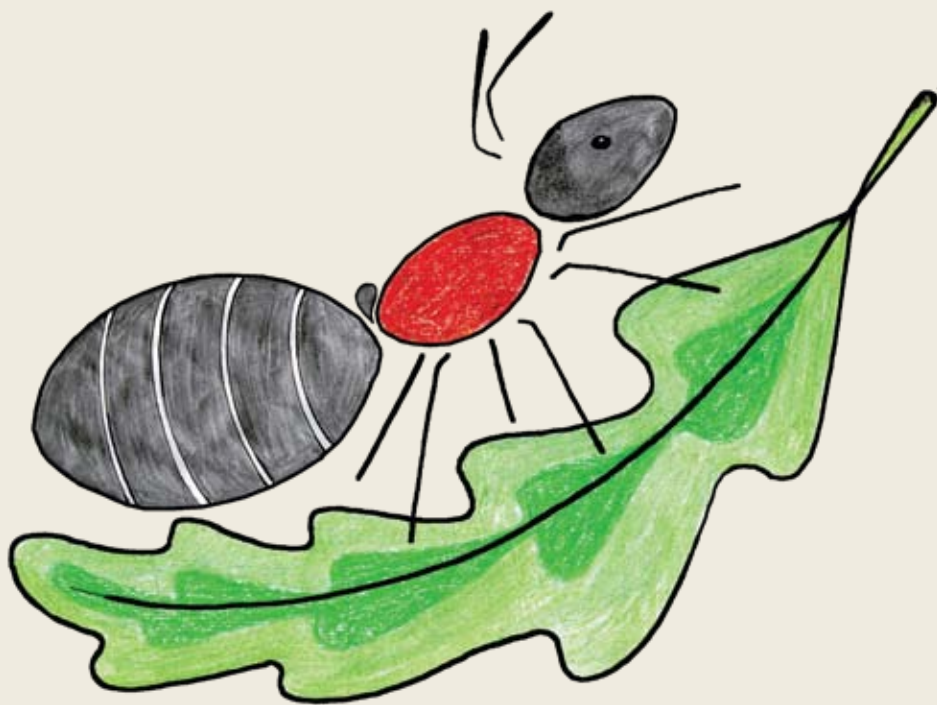


6th Central European Workshop of Myrmecology

Debrecen, 24–27 July 2015
University of Debrecen



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Program

24th July, Friday

- 16:00 Arrival and registration at the Lifescience Building
18:30 **Welcome reception at the Lifescience Building**

25th July, Saturday

- 09:00 Registration
10:30 Patrizia D'ETTORRE: Social recognition in ants: complex signature mixtures and simple identity signals (*Plenary talk*)
11:30 **Coffee break**
12:00 Abel BERNADOU, Jürgen HEINZE: Hierarchy formation and division of labor in a clonal ant
12:20 Stepanka KADOCHOVA, Flavio ROCES, Jan FROUZ: Sunning behavior in Red Wood Ants
12:40 Patrick KRAPE, Lucia RUSSO, Wolfgang ARTHOFER, Birgit Christiane SCHLICK-STEINER, Florian Michael STEINER: Colony structure in *Tetramorium alpestre* ranges from intraspecifically aggressive monogyny-monandry to supercoloniality
13:00 **Lunch at the Nagyerdei Restaurant**
14:30 Zhanna REZNIKOVA, Natalia ATSARKINA, Sofia PANTELEEVA: *Myrmica* ants are talkative when young
14:50 Anna Á. SOMOGYI, András TARTALLY, Zoltán BARTA: Colony state and personality measure at *Formica fusca* workers
15:10: Abraham HEFETZ, Mamiko OZAKI: Neural mechanisms and information processing in ant recognition systems

- 15:30 **Coffee break**
- 16:00 Xim CERDA, Elena ANGULO, Irene VILLALTA, Fernando AMOR, Raphaël R. BOULAY: Can global warming impact the foraging activity of thermophilous ants?
- 16:20 Irena M. GRZES, Mateusz OKRUTNIAK: Morphological traits as a response to chronic metal pollution in *Lasius* ants
- 16:40 Poster session
- 18:30 **Dinner at Átrium Restaurant & Conference photo**

26th July, Sunday

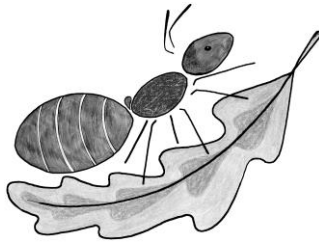
- 9:30 David NASH: Ant social parasites as a window on social evolution (*Plenary talk*)
- 10:30 **Coffee break**
- 11:00 Veronika JÍLKOVÁ, Jan FROUZ: Respiration in wood ant nests is affected by altitudinal and seasonal changes in temperature
- 11:20 Bálint MARKÓ, Katalin ERŐS, István E. MAÁK, Hanna BABIK, Piotr SLIPINKSI: Pollen as alternative source for submissive species in suboptimal circumstances
- 11:40 Tali REINER BRODETZKI, Serge ARON, Abraham HEFETZ: Diversity of Social and Population structure in species of the desert ant *Cataglyphis* in Israel
- 12:00 Gema TRIGOS PERAL, Joaquín REYES LÓPEZ: Ants in urban green: Their relationship with the environment in a 10-year study in the south of the Iberian Peninsula

- 12:30 **Lunch at Nagyerdei Restaurant**
- 14:00 Ferenc BÁTHORI, Walter P. PFLIEGLER, András TARTALLY:
Occurrence of ant parasitic Laboulbeniales fungi in the Carpathian Basin
- 14:20 Enikő CSATA, Dalma MOLNÁR, Emese-Anna KÖTŐ, Bálint MARKÓ,
Elena RÁKOSY-TICAN: Sanitary behaviours induced by fungal infection
in *Myrmica scabrinodis*
- 14:40 Walter P. PFLIEGLER, Ferenc BÁTHORI, András TARTALLY:
Molecular genetic investigations of the enigmatic *Rickia wasmannii*
(Laboulbeniales), a fungal parasite of ants
- 15:00 **Coffee break**
- 15:30 István E. MAÁK, Paolo HENRIQUE, Orsolya JUHÁSZ, Eszter TÓTH:
Fungal infection as imminent threat - the responses of *Formica polyctena*
workers towards the nestmate corpses in different infection stages
- 15:50 Matthias FÜRST, Thomas EDER, Sylvia CREMER: Viral diversity in ant
communities
- 16:10 Jürgen HEINZE, Nana GRATIASHVILI: High skew in the Caucasus:
functional monogyny in the ant *Leptothorax scamni*
- 16:30 Herbert C. WAGNER, Wolfgang ARTHOFER, Florian M. STEINER,
Birgit C. SCHLICK-STEINER: New insights into the taxonomy and
evolution of the *Tetramorium caespitum/impurum* complex
- 17:00 **City tour**
- 18:30 **Starting to Farewell Dinner at Erdőpuszta Club Hotel**

27th July, Monday

- 09:00 Wine tasting and field trip

Plenary presentations



Social recognition in ants: complex signature mixtures and simple identity signals

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Communication of identity allowing recognition of group members is essential for the evolution and stability social life. Social insects use primarily the chemical channel for communicating social identity through multi-component cues and signals. In ants and other social insects, social interactions are regulated by at least three levels of recognition.

Nestmate recognition occurs between colonies, is usually very effective, and involves fast processing of signature mixtures (blends of cuticular hydrocarbons). Cuticular hydrocarbons differ in structure, with consequences on their perception, functional role and heritability.

Within a colony, division of labour is enhanced by recognition of different classes of individuals. Pheromones are involved in signalling reproductive status and regulating reproductive conflicts. In some cases, a single hydrocarbon can act as queen pheromone conveying honest information about quality of the sender and thus controlling worker reproduction. Lastly, in particular circumstances, such as cooperative colony founding with stable dominance hierarchies, ants are capable of chemically based individual recognition. Social context helps predicting recognition systems and the underlying recognition cues. However, we know very little about how chemical cues and signals are detected and processed by the ants. Neural mechanisms of information processing might be specific to each recognition level. Their integrated understanding can contribute to the understanding of social systems in general and their evolutionary stability.

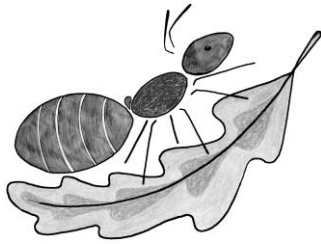
Ant social parasites as a window on social evolution

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While there are several types of social parasites of ants, those that are themselves ants have a unique evolutionary history that can potentially shed light on various aspects of the evolution and maintenance of eusociality. In particular, inquiline social parasites have often lost their worker caste and so have effectively become the only non-social ants. This transition from sociality to asociality has occurred multiple times in different ant lineages, and so common evolutionary patterns across inquiline social parasites can provide information on what it takes to be social and to maintain sociality. Patterns of change in the morphology, physiology and behaviour of social parasites can give clues as to how phenotypes are associated with sociality, and next generation sequencing techniques can potentially allow us to examine the underlying genomic basis of such changes. The evolution of social parasitism appears to be one of the few cases where sympatric speciation may be common, or even the rule, which also leads to some predictions about how we can potentially identify parts of the genome under selection. In this talk, I will give an overview of the current state of the art of using social parasites as a tool to examine the evolution of sociality, as well as examining some of the unique features of social parasites that should also be taken into account.

Oral presentations



Occurrence of ant parasitic Laboulbeniales fungi in the Carpathian Basin

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The order Laboulbeniales (Fungi, Ascomycota) is a little-studied group of microscopic ectoparasites of invertebrates, mostly of insects. Thus far, four species of these fungi have been reported to be associated with ants in Europe: *Rickia wasmannii* is found in 15 countries; *Laboulbenia formicarium* in France, Portugal and Spain; *Laboulbenia camponoti* in Bulgaria and Spain; and *Rickia lenoirii* in Greece and France. Until 2014 only *R. wasmannii* has been reported among these four fungi in the Carpathian Basin from *Myrmica scabrinodis*, *M. slovacica*, *M. speciosoides* and *M. vandeli*.

Our aim was to prove the presence of the other three ant-parasitic Laboulbeniales species within this region by checking museum and field samples.

Laboulbenia camponoti was recorded from the Romanian and Austrian parts of the Carpathian Basin from *Camponotus aethiops*. *Rickia lenoirii* was found for the first time in the Romanian and Hungarian parts of this region from *Messor structor*. *Laboulbenia formicarium* was not found despite the thorough survey of its well-known host, *Lasius neglectus*.

These facts offer a new picture for the potential distribution of these fungi, as they can be found in more northern regions than previous records suggested. We would like to encourage here myrmecologists and mycologists to search more intensively for these minute but interesting species.

This study was supported by the 'AntLab' Marie Curie Career Integration Grant within the 7th European Community Framework Programme; AT was supported by a 'Bolyai János' scholarship of the Hungarian Academy of Sciences (MTA).

Hierarchy formation and division of labor in a clonal ant

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Division of labor in insect societies is one the tenets of eusociality. However, the proximate factors underlying task allocation and specialization in social insects are not yet fully understood. For example, there is firm evidence for a role of genetic variation, morphology, individual experience or developmental factors in the propensity of individuals to take over particular tasks. Clonal ants are ideal models to investigate the proximate mechanisms underlying division of labor, while avoiding confounding factors, such as variation in genotype or morphology. In the tropical ant *Platythyrea punctata*, division of labor is based on rank orders that are established by young workers through fighting. In consequence, each colony contains only one, rarely several, reproductive workers, while the majority of individuals has inactive ovaries.

In this study, we tested whether clone (i.e. colonies) origin influences the propensity of workers to become a dominant or submissive individual (i.e., the reproductive division of labor). Through behavioral observations,

we followed the formation of hierarchies in nest composed of two callows of different genetic lineages. Our results show that a hierarchy readily appears between workers within a few days and that clone origin affects in some cases division of labor.

Can global warming impact the foraging activity of thermophilous ants?

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Cataglyphis desert ants are widespread over the Mediterranean basin and arid regions of the Old World. They are highly heat-tolerant species: foraging activity of colonies is strictly diurnal, with greatest activity taking place during the midday hours, when soil temperatures are highest. Heat-tolerance allows *Cataglyphis* workers to collect dead arthropods when most of their less heat-tolerant competitors are inactive.

We have studied daily and seasonal foraging activity in 4 Spanish *Cataglyphis* species: *C. cursor* and *C. iberica* (Barcelona, NE Spain) and *C. floricola* and *C. tartessica* (Doñana, SW Spain). From March to October, one day per month, we monitored the activity in the field (4-8 nests per species). Soil surface temperature was recorded at the same time. Critical thermal maximum temperature (CTM) was estimated in the laboratory for each species.

Each species maximum foraging activity temperature (MAT) was very close to their CTM: *C. cursor*: 48 and 50; *C. iberica*: 50 and 52; *C. floricola*: 44 and 50; *C. tartessica*: 46 and 50°C. Since they forage very close to their physiological limits, they run a high risk of mortality due to thermal stress. This risk may be beneficial as it increases the foraging success of *Cataglyphis* ants by allowing them to forage on valuable food sources. However, a problem may arise if ground temperature increases, even by a few degrees. We have estimated ground temperature values through projection onto IPCC future conditions data (RCP2.6 and RCP8.5 scenarios). According to these predictions, in the hardest scenario, some of these thermophilous ants would have to stop the activity at midday (when they are highly performant).

Sanitary behaviours induced by fungal infection in *Myrmica scabrinodis*

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Ants are frequently targeted by parasites, and in some cases parasites induce changes in life history, physiology and behaviour of the hosts. The social life of ants implies high frequency of contacts among nestmates, that

increases the risk of spreading any pathogen among colony members. *Rickia wasmannii* is an ectoparasitic fungus of the order Laboulbeniales (Ascomycetes), that obligatorily exploits ant species of the genus *Myrmica*. Little is known about its exact interactions with its hosts. In the frame of laboratory studies we investigated the changes that the parasite could induce in the behavior of the host. We performed two different experiments: (1) we recorded the time elapsed to the discovery of infected corpses (uninfected corpses were used as control), and the ants' reactions to them, e.g. the number of aggressive behavioural acts; (2) we recorded the frequency and the time of auto- and allo-grooming behaviour of infected and uninfected ant individuals. Our results suggest that infection with *R. wasmannii* seems to modify, although to lesser extent, the behaviour of infected individuals.

Viral diversity in ant communities

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Viruses are important infectious pathogens, regularly causing epidemics in societies, whether human or social insect. While research has made considerable progress in understanding viral infections in vertebrate societies, our knowledge in social insects is nearly exclusive to honey bees as important pollinators and fire ants, a serious pest species. Almost all studies available focus on single viral infections rather than multiple viruses present in a host population, taking the pathogen community into account. In

this study we explore the natural viral component communities, different virus species populating a single host species, of three host ant species from three different subfamilies across various sampling sites. Next generation sequencing allows us to catch the whole viral diversity within the sampled host populations. We will highlight conserved viral community patterns within single host species across our sampling sites. For a deeper understanding of natural host pathogen systems the new techniques at hand offer valuable insights into complex ecological communities like multi-host multi-pathogen systems.

Morphological traits as a response to chronic metal pollution in *Lasius* ants

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Chronic exposure to metal pollution may affect the living organisms on different level of biological organization. The aim of this study was to describe the body size of *Lasius niger* and *Lasius flavus* and to test if parameters of size distribution correlate with metal pollution. We measured head width in both species and eye diameter in *L. flavus*. All measurement were done using digital methods. Ants were collected from apx. 100 colonies (*Lasius niger*) and 50 colonies (*Lasius flavus*) originating from 19 sites located along pollution in post-mining area in Poland. Eyes in *L. flavus* are vestigial structures and being not under selective pressure they might accumulate mutations faster than other morphological traits. Therefore, we expected that the difference between left and right diameter of eye will increase with metal pollution gradient. The results shown that in both species body size differed considerably between colonies, but averages were not

related to metal-pollution level. However, in both species the skewness of head size distributions calculated for each colony correlated positively with metal level, suggesting that the proportion of small ants increased with increased metal pollution. In turn, the left-right differences in eye diameter of *Lasius flavus* showed relatively low between-colonies variability and remained unrelated to metal pollution level.

This study was supported by The National Science Centre (Narodowe Centrum Nauki, NCN), based on decision DEC- 2011/01/D/NZ8/00167.

Neural mechanisms and information processing in ant recognition systems

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Nestmate recognition in ants is based on the match/mismatch of an identity signal that the member of the society carries with that of the perceiving individual. While the response to match/mismatch, amicable or aggressive, is very clear, the neural systems leading to recognition are yet not fully understood. Here we contrast two alternative hypotheses for the neural mechanisms that are responsible for the perception and information processing in recognition. We focus on recognition via chemical signals since this is the common modality in social insects. The first classical hypothesis states that upon perception of recognition cues by the sensory system the information is passed as is via the antennal lobes to higher brain center where the information is deciphered and compared to a neural template. Match or mismatch information is then transferred to some behavior switching or locomotion pattern generating centers where the

appropriate response is elicited. We would like to present an alternative hypothesis, that of "pre-filter mechanism" whereby the decision whether to pass on the information to the central nervous system already takes place at the peripheral sensory system. We propose that through sensory adaptation only alien signals are passed on to the brain, specifically to an "aggression center" where the response is generated if the signal is above a certain threshold. Accordingly, nestmate odors, being very similar to each other are below the perception threshold and do not generate any peripheral neural activity, whereas alien ant odors are sufficiently different to elicit both peripheral neural response and activate the aggression center in the brain. Members of a supercolony, although bearing odors that maybe different from nestmates, these differences are apparently below the threshold of perception and therefore may generate a weak peripheral neural activity that is, nonetheless, below the activation threshold of the brain aggression center.

High skew in the Caucasus: functional monogyny in the ant *Leptothorax scamni*

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Animal societies vary considerably concerning how reproductive rights are partitioned among individual group numbers ("reproductive skew"). Queens of most ant species contribute more or less equally to the brood, but queens of a few species of the genus *Leptothorax* form dominance hierarchies in which only the top ranking queen lays eggs ("functional monogyny"). In accordance with optimal skew models, high skew appears to be associated with habitat patchiness. Here we document functional monogyny in the Caucaso-Anatolian ant *Leptothorax scamni* (Ruzsky, 1905), as has been suggested previously based on the habitat of this species.

Like in related species, young female sexuals mate on the ground near their natal nests and thereafter either disperse to found new colonies solitarily or in groups or return into their natal nest, where only one of several co-occurring queens reproduces. A phylogeny based on partial *COI* sequences corroborates the view that functional monogyny has evolved convergently in several taxa of *Leptothorax* and is thus a relatively labile trait that can rapidly adapt to habitat changes.

Respiration in wood ant nests is affected by altitudinal and seasonal changes in temperature

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Wood ants maintain stable high temperatures in nest centers from April to September to support brood development. Similar nest temperatures have been recorded regardless of latitude and altitude, suggesting that nests from colder environments produce more heat than nests from warmer environments. We measured changes in temperature and in situ respiration in nests from 700 and 1000 m a.s.l. We also sampled ants and nest materials from the same nests and measured their respiration in the laboratory. Both ant and microbial respiration increased greatly as temperature increased in spring, especially at 1000 m, resulting in the increase in nest temperature in spring. Nests from 1000 m maintained similar temperatures as nests from 700 m in summer but were colder in winter. Ants were responsible for the maintenance of high temperatures during summer.

Sunning behavior in Red Wood Ants

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Red wood ants *Formica polycтена* are known for their conspicuous nest mounds, which serve not only as a shelter for adults but mainly as an incubator for the brood. In spring we can observe conspicuous behavior of ant workers; they cluster on nest surface in big numbers and bask in the sun. Shortly afterwards a rapid increase of nest temperature follows. Sunning behavior is a unique phenomenon observed in wood ants only. We performed laboratory observations of sunning behavior in *F. polycтена* and revealed that not all ants take part in sunning, there are “sunnings” and “nonsunnings”. Proportion of sunning ants may differ between colonies and also with the date. We found no morphological or physiological differences between sunning and nonsunning ants, the mortality rate was also equal. We measured body temperature and respiration rate of sunning ants and observed that the metabolism (approximated from respiration rate) of sunning ants temporally increases because of increased body temperature. Going from 5 to 35°C causes ten times increase in respiration rate. However this difference doesn’t persist. Thus we assume that spring self heating of nest mound is not caused by an increase in ant metabolism triggered by sunning event but by physiological transport of heat in ant bodies.

Colony structure in *Tetramorium alpestre* ranges from intraspecifically aggressive monogyny-monandry to supercoloniality

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Social organisation is key to animal societies and, ecologically viewed, influences intraspecific and interspecific coexistence. Ant communities display various social structures from, e.g., monogynous, monandrous colonies inhabiting single nests to polygynous, polyandrous colonies living in multiple nests. This social polymorphism occurs both across and within species, such as in *Myrmica rubra*, *Formica selysi*, *F. rufa*, *F. polychena*, and *Tetramorium alpestre*. Intraspecific polymorphism might represent steps towards the formation of supercolonies – large to very large collectives of nests with multiple queens, where intraspecific aggression is absent and individuals of different nests mix.

Tetramorium alpestre is an Alpine endemic belonging to the cryptic *T. caespitum* / *impurum* complex. It lives in mats between 1300 and 2300 m a.s.l. By genotyping workers from separate Eastern-Alpine locations at nine microsatellite loci, we detected both polygynous and monogynous nests of *T. alpestre*, corroborating the existence of polygyny suggested by former, non-molecular investigations. In contrast, monogyny had not been

encountered so far and revealed a social polymorphism in *T. alpestre*. Pairwise aggression assays mostly revealed absent or reduced aggressive behaviour between workers of different nests, except for one location, where battles occurred more frequently than in any other pairing. Further investigations should provide new insight in the factors triggering intraspecifically aggressive or non-aggressive monogyny-polygyny or supercoloniality in *T. alpestre*.

Fungal infection as imminent threat - the responses of *Formica polyctena* workers towards the nestmate corpses in different infection stages

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Social life, beside its advantages can have many health risks, because the high number of individuals and intensive group activities can lead to the accumulation of wastes in elevated amounts on which many parasites and pathogens can settle. Furthermore, the conditions inside the nest can favour the spread of such infections. In ants a bigger part of the waste is formed usually by the corpses of the nest-mates, which can be used even as food source by some species. These features assume the presence of a very sophisticated pathogen recognition system, causing the low prevalence of such infections, which otherwise could easily lead to lowered fitness and even colony death. We examined under laboratory conditions the reactions of the

territorial ant species, *F. polyclena* towards the nestmate corpses infected with the spores, hyphae, and hyphae with conidia of the entomopathogenic fungi *Beauveria bassiana*. For our investigations we used corpses submerged in a 10^8 spore-suspension (1), corpses left outside until the development of the hyphae (2) and conidia (3), and controls without infection, respectively. We made several observations on the development circumstances of the fungus, and noted down the behavioral reactions of the nestmates towards the different types of infected corpses, and the rate and direction of the corpse transport. Our results showed that the corpses with conidia elicited a more intensive and aggressive reaction than the controls and those infected only with hyphae and spores. These corpses elicited a high amount of cleaning behavior and a fast transport away from the colony. The treated corpses in every case were removed faster, than the control corpses. Surprisingly some of corpses with spores and even hyphae were transported inside the nests. On the basis of our results we can hypothesize the presence of a very efficient corpse and infection recognition system.

Pollen as alternative source for submissive species in suboptimal circumstances

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Insects are known to be the most important pollinators. However, ants are usually considered to be poor pollinators due to their negative effect on flowers and pollen survival. Plants apply various strategies to repel ants from flowers. Consequently pollen consumption is very rarely observed in ants, and, though they are omnivorous, ants are not commonly considered as pollenivores. In suboptimal circumstances, though, species might turn to sources rarely used before. Such suboptimal conditions may arise under strong competitive pressure, as the presence of a supercolonial territorial ant species. We studied the food preferences and competitive strategies of ants within a *Formica polychteta* supercolony in Central Polish woodland by offering them mixed pollen, and then tuna as animal protein source on the next day. *F. polychteta* was not interested in pollen baits almost at all, however, *Myrmica* spp. exploited them most heavily where next day *F. polychteta* was the most abundant on baits. In the case of the tuna baits there was a negative relationship between the abundance of *F. polychteta* and *Myrmica* spp. as predicted by the territorial behaviour of the first species. The results come to support the fact the pollen itself can be used as food source by ants mostly in suboptimal conditions, where food availability is hindered e.g. by superior competitors.

The study was carried out in the frame of joint research program of the Romanian Academy and Polish Academy of Sciences.

Molecular genetic investigations of the enigmatic *Rickia wasmannii* (Laboulbeniales), a fungal parasite of ants

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Laboulbeniales are one of the morphologically most distinct and evolutionarily most enigmatic groups of fungi. Phylogenetic studies on these parasites are rare and hindered by difficulties in DNA isolation and the unculturable nature of Laboulbeniales. Using the relatively well-known *Rickia wasmannii* that is associated with *Myrmica* spp. ants, we aimed to develop a new DNA-isolation method for molecular phylogenetic studies on Laboulbeniales and to characterize phylogenetic relations, and geographic vs. host-specific diversity of the species. Our developed technique enables quick and reliable DNA-isolation for PCR-based studies for Laboulbeniales and requires as few as 3-4 fresh or ethanol-preserved thalli. PCR-reactions carried out with phylogenetically informative genes of *Rickia* could be used to assess its phylogenetic position on the Ascomycota tree of life and to compare its sequences between different populations in the Carpathian Basin.

This study was supported by the 'AntLab' Marie Curie Career Integration Grant within the 7th European Community Framework Programme; AT was supported by a 'Bolyai János' scholarship of the Hungarian Academy of Sciences (MTA).

Diversity of Social and Population structure in species of the desert ant *Cataglyphis* in Israel

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The remarkable diversity of ant social organization, which affects both their life history and population kin structure, can be exemplified in the genus *Cataglyphis*. Species in this genus demonstrate high variation with respect to both social structure and mating strategies, from the ancestral colony type that is composed of a single queen (monogyny), singly inseminated (monoandry), and to the more derived states of colonies headed by multiply inseminated queens (polyandry) and colonies composed of multiple queens (polygyny). Moreover, the population structure of *Cataglyphis* species may range from multicoloniality via polydomy to supercoloniality. We compare the social structures of three species in the group using a multidisciplinary approach encompassing behavior (nest insularity/openness), chemistry (composition of the recognition cues, GC analysis of CHC's), and genetics (microsatellite polymorphism). Our study of two species, *C. niger* and *C. savignyi*, revealed that despite being phylogenetically related they display quite different life histories. *C. savignyi* is monogyne and multicolonial, whereas *C. niger* is polygyne and show transition from polydomy to unicoloniality. New evidence unravels the social and population structure of *C. drusus*, as well as its biogeography. *C. drusus* dwells in semi stabilized sand dunes along the cost in the north part of Israel. Results show that the population from the plot investigated in the Betzet locality has a multicolonial structure and that the nests are monogyne with multiply inseminated queens.

***Myrmica* ants are talkative when young**

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In many ant species workers do not display explicit correlation between age and task performance. Thus, in several species displays of the behavioural syndrome were revealed, that is, stable sets of behaviours related to personal traits rather than age. However, maturation of personality apparently is important in task partitioning. We are trying to investigate how antennal communication in *Myrmica rubra* change with age. In this study we compared the mode of communication in very young (5-10 days old) workers with that of adult ones.

The experiments were performed on foragers and queens of the *M. rubra* colony of about 1000 workers with 20-30 queens, housed in the laboratory in the artificial nest. In experiments we placed marked ants pairwise into Petri dishes in combinations young–young (5 pairs), young–adults (7), and adult–adult (7). We analyzed video records of their behaviour selecting five minutes periods corresponding to the 5-10, 11-16, and 15–20 minutes of the whole interaction. Our preliminary results show that young ants spend much more time for antennal contacts with each other as well as with adult ones, although adults initiate contacts more frequently. Antennal movements are much slower in young ants and less ordered than in adults, that is, antennae move discordantly, and the mode of antennal contacts in young looks like investigative touching rather than transferring signals.

Adults spend essentially less time in contacts with other adults than with young ones. However, they initiate trophallaxis with young ants more frequently than with other adults, although this does not always end with real food exchange. All this suggests that both maturation and social contacts are necessary to shape the mode of antennal communication in *Myrmica* ants, and further experiments are needed in order to distinguish between individual and social experience

Ants in urban green: Their relationship with the environment in a 10-year study in the south of the Iberian Peninsula.

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Despite the increasing number of myrmecological investigations in the last decades, the deep ecological surveys carried on in urban green are scarce. This lack of knowledge made us to perform this study, which aim is to determine the influence of age of an urban green area and meteorological variables on the ant fauna.

The study was conducted in the years 2003-2013 in three gardens of different age located on the campus of Rabanales (Córdoba, Spain). By using pitfall traps as the main sampling method, a total of 29 species and 11840 workers were captured. The most abundant species were *Lasius grandis* and *Pheidole pallidula* (33.78% and 30.34%, respectively). It is important to stand out the presence of alien species closely linked to areas affected by man such as *Cardiocondyla mauritanica* and *Strumigenys membranifera*.

The ant fauna differentiation between the gardens was confirmed by a Correspondence Factorial Analysis and Discriminant Analysis with a value of almost 100. A Multiple Regression Analysis shows a negative effect of the average minimum temperature ($R_2=0.6656$, $\beta=-1.30740$, $p=0.005478$) and a positive effect exerted by the average atmospheric pressure ($R_2=0.6656$, $\beta=0.97462$, $p=0.019662$) against the number of taxa in the sampling days. Moreover, the average temperature registered for the two months when sampling was conducted showed negative correlation with the number of taxa ($R_2=0.54537$, $\beta=-0.76014$, $p=0.013955$). These results confirm the strong influence of meteorological variables on ant biodiversity as determinant factors of the number of taxa found along the years, despite urban gardens are ecotopes where these variables are damped by anthropogenic factors.

Colony state and personality measure at *Formica fusca* workers

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Individuals in many species, from invertebrates (insects, spider, etc.) to vertebrates (lizards, birds, mammals, etc.), consistently differ in their behaviour from each other. This phenomenon is usually referred as animal personality. It means that the individuals' behaviour remains similar over time and across context. In social insects at least two level of personality can

be distinguished, individual and colonial level. Division of labour is typical in eusocial insects, most of the tasks, like brood-caring, nest defence or foraging, can be found in most species. Nevertheless, there can be marked differences in the actual level of division of labour between colonies. *Formica fusca* (Linnaeus 1758), common black ant, is a polygyn species with relatively small colony size. In our experiments, we manipulated the actual size of the colony with creating new colonies from the collected ones with one queen, and then measured the workers' personality in open-field tests. We found that most of our behavioural variables were consistent, and the manipulation of colony size had affected the behaviour. It seem that workers from bigger sized colonies behave bolder, furthermore workers from originally multi-queen colonies showed more explorative behaviour.

This study was supported by the Momentum program of Hungarian Academy of Sciences (MTA-DE "Lendület" Behavioral Ecology Research Group).

New insights into the taxonomy and evolution of the *Tetramorium caespitum/impurum* complex

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Delimitation and determination of species within the *Tetramorium caespitum/impurum* complex provoked controversial discussions over the last decades, and fundamental knowledge gaps about this cryptic species complex remain. Based on a multidisciplinary approach, we revise the

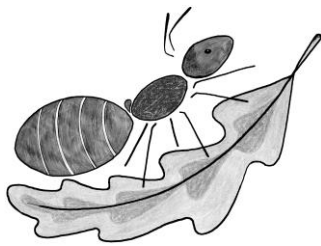
taxonomy and aim to understand the evolution of the *Tetramorium caespitum/impurum* complex.

We collected several thousand nest samples from 35 nations in Europe, Anatolia, the Caucasus, and Central Asia. Our investigation is based on integrative taxonomy, i.e. the combination of independent methods using the same biological samples. About 900 workers were used for traditional morphometric analyses of 32 characters. Qualitative male-genital-structure investigations complement the morphological data. For phylogenetic reconstruction, we sequenced 1,113 bp of the *cytochrome c oxidase subunit 1* gene of more than 1,200 workers and scored amplified-fragment-length polymorphism for more than 500 workers.

Based on our multidisciplinary dataset, we demonstrate the presence of at least 10 well-separated western-Palearctic species and use this insight for our taxonomic revision. Furthermore, we show ecological data and distribution maps of selected species.

Contradictory results of different methods require evolutionary explanations, e.g. intraspecific variability due to geographical distance, interspecific similarity due to morphological stasis and/or incomplete lineage sorting, and hybridization/introgression. We defend the evolutionary stability of the species boundaries we draw because of a considerable congruence of different methodological results of samples across the western Palearctic.

Posters



(I) The ant fauna of Greek Thrace

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The ant fauna of Greece is one of the richest in Europe, with about 280 species recorded. Although the studies of ants in the country became more intensive in the last few years, the geographic region of Greek Thrace (Western Thrace) is still heavily understudied. Checklists report only 12 species for this part of the country. Here we present new data on ants of Greek Thrace, collected at 30 sites throughout the region, mostly in spring 2014. Altogether about 90 ant species were recorded in Greek Thrace. The exact identity of some species remained unclear due to the unresolved taxonomic status in several species-groups of the genera *Messor*, *Temnothorax* and *Tetramorium*. When this ant fauna is compared with the ones from the neighbouring regions of Macedonia, Bulgarian (Northern) Thrace and Turkish (Eastern) Thrace, it is obvious that the number of known species from Greek Thrace is still low. More than half of the species found in Greek Thrace are distributed over all mentioned neighbouring regions. From zoogeographical point of view, the species-richest zoogeographical elements in Thracian ant fauna are the Mediterranean, Euro-Caucasian and Balkan-Anatolian elements. Two species, *Temnothorax aeolius* and *Tetramorium rhodium*, are reported for the first time for the Greek mainland.

(2) Plesiobiosis between *Lasius psammophilus* and *Plagiolepis taurica* in artificial shelters

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Plesiobiosis is a simple form of spatial associations of heterospecific ant colonies that share the same microhabitat, but remain separate as individual units. We studied the frequency of plesiobiosis between, *Lasius psammophilus* and *Plagiolepis taurica*, under slate plates used as artificial nesting sites during a 35 years long study period. 2527 nest records of 11 ant species were made under the plates, and we observed a total of 183 plesiobiotic associations, most of which between *L. psammophilus* and *P. taurica*. Out of four concurrent hypotheses (neutralism, mutualism, strong and weak antagonism), the weak antagonism between the two species was supported by (1) the lower rate of plesiobiosis than expected from random probabilities; (2) the maximum of the index of avoidance at intermediate nest densities; (3) the negative relationship between the unoccupied nesting shelters and the frequency of close nesting; (4) the tendency of individual and group level avoidance and (5) the low rate of interspecific aggression. The benefit of choosing favorable nesting sites and the risk of interspecific competition are in trade-off relation and the attractiveness of nesting shelters is the stronger constraint; therefore it can be regarded as the primary mover of spatial associations between the colonies of the two studied species.

(3) Ants biodiversity and distribution related with the protected areas and National parks in Georgia

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There are 34 Hot Spots recognized in the World with high levels of diversity of species and ecosystems. The Caucasus Ecoregion is one of the most important temperate hot-spots among them.

Generally the Caucasus region and particularly Georgia has exceptionally rich myrmecofauna. Investigation of ants in Georgia started at the end of 80s of the 19th century and with Soviet and foreign scientists were sustained. Up to now 146 species of ants are recorded in Georgia.

Ant species distribution was estimated throughout the Georgia. We collected and mapped the records of Georgian ant species onto a 20 x 20 km square UTM grid to check how effectively the existing network of protected areas covers the hotspots of ant biodiversity and how evenly the sampling intensity is distributed.

The highest number of sampling sites and species richness from 13 regions was fixed in Samtskhe-Javakheti and Kvemo Kartli, then comes Tianeti, Kakheti, Mingrelia and Tbilisi, afterward comes Abkhazia, Shida Kartli and Imereti regions and finally Ajaria, Guria, Racha and Svanetia with their low number of species. Less than half of the richest grid cells is covered by the protected areas. Ant species richness is significantly correlated with sampling intensity meaning that the current knowledge of the distribution of ant diversity could be significantly biased due to sampling effort. On the other hand this also means that more species are to be expected if the region is studied thoroughly

(4) Effects of nutrient-rich substrate and ectomycorrhizal symbiosis on spruce seedling biomass in abandoned wood ant nests

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Coniferous trees can take up mineral nutrients either non-symbiotically from nutrient-rich hotspots in the forest floor or via symbiosis with ectomycorrhizal (EcM) fungi, which enables also to gain nutrients from organic substances. An excellent example of nutrient-rich forest floor hotspots are abandoned wood ant nests which may accumulate significant amounts of inorganic substances readily accessible to roots as well as organic substances that are not accessible to non-mycorrhizal roots. Here we examined the effects of substrates from abandoned wood ant (*Formica polycтена*) nests and EcM symbiosis on biomass of Norway spruce (*Picea abies*) seedlings cultivated in a growth chamber. The tested substrates originated from centers and rims of wet and dry ant nests, and from the surrounding forest floor. Aseptic spruce seedlings were planted in these substrates and incubated in a growth chamber and after seven months, seedling biomass, chemical and microbiological properties of the substrates and EcM colonization and diversity were determined. Spruce seedlings grew better and had more diverse spectra of EcM fungi in the ant nest substrates than in the forest floor substrate. Substrate nutrient content, especially phosphorus and basic cations, positively affected spruce biomass, EcM diversity and fungal biomass. Contrary to the popular opinion, high nutrient contents in ant nests as nutrient-rich hotspots had a positive effect on EcM abundance and diversity. Although the density of abandoned wood ant nests

in temperate and boreal forests is usually low and they are thus unlikely to have an effect at the ecosystem level, they may cause significant local variations in tree growth and occurrence of root symbiotic fungi.

(5) A revised ant list of Turkish Thrace with some new additions

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The most recent popular taxonomic study among researchers is preparing checklists of ants of various countries based on previous literature data and newly collected material. Concordantly, the ant checklists of Turkey and its neighboring countries (Armenia, Bulgaria, Georgia, Greece, Iran etc.) have been prepared and published in reaction to this popular trend. Kiran and Karaman reported 306 ant taxa from Turkey and 160 taxa from the Turkish Thrace (European part of Turkey) in 2012 while reporting 73 and 49 ant taxa from Istanbul and Çanakkale, respectively. However, they did not prepare a separate list in private for the species of the Turkish Thrace region or mentioned the species which were known from the region. This situation apparently causes a “chaos” because Istanbul and Çanakkale have regions represented in both European (Turkish Thrace) and Anatolian parts of Turkey. We prepared a revised ant list of Turkish Thrace, recorded 1 genus and 7 species for the first time from the region and also excluded 9 species from the species list of the region. Thus, according to the current updated list, the region is represented by 163 taxa (162 species and 1 subspecies) from 37 genus within 6 subfamilies.

**(6) A new species of the genus *Carabera* Westwood
(Hymenoptera; Formicidae) from Turkey**

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The genus *Carebara* is widespread especially in the tropics and subtropics and is represented by 200 species and 22 subspecies. Until quite recently, the genus is represented in the Western Palearctic Region by one species, *Carebara oertzeni* Forel which was described from Greece and one subspecies, *C. oertzeni* subsp. *aeolia* Forel described from Turkey. *C. oertzeni* subsp. *aeolia* was recorded from Izmir by Forel in 1911 and Ettershank gave its distribution as Turkey in his revisionary study in 1966. On the other hand, Borowiec gave *C. oertzeni* as senior synonym of *C. oertzeni* subsp. *aeolia* in his monograph in 2014. Thus, the genus is represented by one species in the Western Palearctic Region. Moreover, the genus could not be recorded from Turkey or any other region within Western Palearctic for more than 100 years. In this study, we described a new species, *Carebara resati* n. sp., of the genus from Edirne in European part of Turkey and reported some morphological and biological notes on the new species.

(7) Ant Fauna (Hymenoptera, Formicidae) of Eastern Black Sea Region of Turkey

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This study was performed to determine the ant fauna of the Eastern Black Sea Region of Turkey. A total of 297 localities in 39 different habitats at various altitudes from sea level (0 m.) to 2965m. asl. were investigated in the region during a 58 days field study in 2012-2013.

A total of 142 species from 32 genera within 4 subfamilies (Dolichoderinae, Formicinae, Myrmicinae, Ponerinae) were determined. The fauna of the study region was represented so far with 57 species from 17 genera within 2 subfamilies. The present study reported 2 subfamilies (Dolichoderinae and Ponerinae), 14 genera and 92 species for the first time for the Eastern Black Sea Region.

The results also showed that 1 genus and 12 species were recorded for the first time for Turkish ant fauna. Moreover, 7 species were recorded in Anatolia for the first time within this study, and presence of 3 species, which were formerly recorded from Turkey without specific locality information, was confirmed.

The field studies revealed that 21 species in the region lived in nests of other ant species as social parasites. Among these social parasites, *Teleutomymrex* sp., a member of a rare and “ultimate parasitic” genus (an extreme form of parasitism) with representatives *T. schneideri* and *T. kutteri* reported so far from Swiss and French Alps, Spain Pyrenees and

Turkmenistan, was obtained in a *Tetramorium chefketi* nest within the present study.

The overall findings increased the number of members of Eastern Black Sea Region ant fauna from 57 to 152, and the number of taxa represented in Turkey ant fauna from 352 (337 species, 15 subspecies) to 364.

This study was supported by TUBITAK (The Scientific and Technological Research Council of Turkey) (Project No: 111T811).

(8) Functional role of oxytocin-like neuropeptide signalling in ants

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Neuropeptide signalling of oxytocin and vasopressin and their receptors have been well studied in humans, mammals and other vertebrates, and their biological function includes osmoregulation, reproduction, complex social behaviour, memory and learning. The role of their invertebrate homologs on the other hand is poorly understood, although this could provide insight about the evolution of these ‘ancient’ peptides

signalling systems, and be useful for pharmacological applications. We are particularly interested in the oxytocin-like insect homologs (inotocin) of ants for several reasons: (i) in recent years many genomes of different ant species have been sequenced and the putative inotocin precursor and receptor were discovered in those genomes, whereas previous work reported the absence of oxytocin-related neuropeptides in other social insects like the honeybee; (ii) inotocin could regulate individual physiology and social organization in ant colonies and (iii) the biological function of inotocin and its receptor has so far only been studied in one other non-social insect species (*Tribolium castaneum*). We have chosen two ant species, *Lasius neglectus* and *Lasius niger*, which are closely related genetically, but significantly differ in their ecology and colony structure. *L. niger* has only one queen per colony (monogyny) while *L. neglectus* as an invasive species has many queens per colony (polygyny) and forms huge supercolonies.

Our aim was to quantify expression levels of both the receptor and the inotocin peptide precursor in different parts of the body and developmental stages in ants using quantitative PCR. Preliminary results indicate that the expression patterns of inotocin and its receptor are different in distinct insect species and provide further hints about diverse biological functions of this important peptide signalling system.

(9) Tool use and preference in the foraging of *Aphaenogaster subterranea* (Hymenoptera: Formicidae)

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In ants, three forms of tool use have been described. The first one is the construction of nests in weaver ants by using the silk of larvae, which are held and manipulated by workers during nest-building. The second form serves to interfere with competitors in some desert ants by plugging the nest entrances of rival colonies with stones. The third form, which is characteristic to the genus *Aphaenogaster*, is when foragers drop debris into liquid food, and then transport the food-soaked tools back to the nest. The main adaptive advantage of this behaviour is that foragers are capable to transport much larger quantities of liquid food by tools than by internal transport.

In our study, we examined the tool use and preference of *Aphaenogaster subterranea* in laboratory experiments. Three types of baits (water, honey water, honey) were used separately, and five types of objects were provided as tools for ants (small and large soil grains, and pieces of pine needles, leaves and sponges). We conducted two experimental situations; in the first one, tools were placed 4 cm from the baits, while in the second one, this distance was raised to 12 cm. The aim of our experiments was to find out whether there is a preference for some tools and whether tool preference changes as a function of bait type and/or the distance between the baits and tools provided.

The workers of *A. subterranea* mostly preferred small soil grains, the most easily movable tools. However, as the distances between the baits and tools increased, the frequency of the usage of the less easily movable tools also increased, thereby reducing the labour and time involved. Tool preference varied as a function of bait type. While in the case of water, pine needles were the mostly preferred tools, small soil grains were dropped most frequently into the liquid foods. Overall, tool dropping into water was significantly less intense than in the case of liquid foods, and tools were never observed to be removed from the water.

(10) The effects of early social environment on behaviour of young workers of the ant *Formica polyctena* during confrontations with callow allospecific ants

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The influence of social context and various forms of social deprivation on expression of ant aggressive behaviour is well documented in a wide range of ant species. However, the impact of the size of a group of newly eclosed ant workers on various features of their subsequent aggressive and non-aggressive behavior is little known. We investigated behavioural differences between young workers of the red wood ant *Formica polyctena* isolated immediately after eclosion and during the subsequent 21 days kept in worker groups (single age cohorts) composed of 5 or 50 individuals. Only the nests in which no ant died during that period were used as the source of workers for dyadic aggression tests during which young workers of *F. polyctena* reared in small vs. large groups ($n = 33$ out of 9 nests and $n = 38$ out of 5 nests, respectively) were paired with callows of *Lasius flavus*. We used as opponents small allospecific callows to avoid escalated aggression directed to the tested workers of *F. polyctena* by their adversaries. We hypothesized that workers of *F. polyctena* reared in larger experimental

groups will be more active and more aggressive than workers of the same age reared in smaller groups. The behaviour of the tested dyads of ants was video-recorded during 10 min and then analyzed by means of the software Behaview. The analysis of the obtained behavioural data confirmed our hypothesis. Workers of *F. polycтена* reared in larger groups were both more active and more aggressive than similarly aged ants reared in smaller groups. In particular, they showed lower propensity for total immobility and resting and at the same time engaged more readily in locomotory activity and biting not accompanied by gaster flexing. Workers of *F. polycтена* that responded to callows of *L. flavus* by charges and by biting accompanied by gaster flexing engaged in these behaviour patterns after a shorter latency from the start of the test if they have been reared in a larger group.

(11) *Crematogaster* ants associate with myrmecophytic *Korthalsia* palms and improve their condition

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Many ant-plant interactions have mutualistic nature and play a major role in ecological and evolutionary processes. In a tropical rainforest of Borneo, we studied the effect of *Crematogaster* ants inhabiting *Korthalsia furtadoana* palms (Aracaceae) on fitness components of their hosts. This myrmecophytic rattan species produces domatia, which can be utilized as nesting space by ants. We hypothesized that ants increase protection of host plants against herbivore damage and epiphyll overgrowth. We found 41 individuals of *K. furtadoana*, but only 14 was currently occupied by ants. On average, 19% of leaves in ant-inhabited plants had signs of a physical damage, compared to 52% in ant-free plants, which also had leaves eight times more overgrown by epiphylls than the ant-inhabited plants. These

results provide the first evidence that the relationship between *K. furtadoana* and *Crematogaster* ants has mutualistic character and accord with observations that ants associated with plants are characterized by increased aggression and cleaning behavior. Ant-plant mutualisms are fine example of a complex, interconnected ecosystem structure characteristic for the tropics. The relationship that we studied here is surely a promising study system for the future research.

(12) The effect of familiar vs. unfamiliar surroundings on nestmate rescue behaviour of workers of two ant species, *Formica cinerea* and *Myrmica ruginodis*

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Ant rescue behaviour is a form of altruism in which one or more individuals come at the rescue of another individual facing a dangerous situation. Various factors influencing ant rescue behaviour were investigated mostly by means of a simple laboratory bioassay consisting of a confrontation of a group of rescuers with an entrapped victim tethered to a piece of paper by means of a snare passing over its petiolus. Another bioassay used in both laboratory and field research on ant rescue behaviour consists of a confrontation of one or more rescuers with a victim captured by a predator, an antlion larva. We used both these bioassays to investigate the effect of presence/absence of chemical cues left by nestmates (= familiar vs.

unfamiliar surroundings) on rescue behaviour of workers of two ant species, *Formica cinerea* Mayr and *Myrmica ruginodis* Nyl. In the case of workers of *F. cinerea*, antennal contacts of the rescuers with the victim and rescue behaviour (attempts to free the victim) were observed frequently in both types of bioassays. We did not discover significant effects of familiar vs. unfamiliar surroundings on behaviour of *F. cinerea* rescuers, which implies that in that ant species providing rescue to a nestmate in distress has priority over information gathering even in unfamiliar environment. Our findings also provide further evidence that rescue behaviour is not a universal phenomenon among ants. Workers of *M. ruginodis* showed lesser propensity to engage in antennal contacts with the victims than workers of *F. cinerea* and only exceptionally engaged in rescue behaviour irrespectively of the type of the bioassay. Evolution of different species in different environmental conditions is likely to be the ultimate cause of the observed inter-specific variability of responses to the same test situations.

(13) Same place, different stories – Ant and plant communities in the highly polluted area of Copșa Mică (Transylvania, Romania)

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The effects of heavy metal pollution can influence the growth, development and survival of both plant and animal species. Despite being known as reliable bioindicators scarce data is available on the impact of heavy metal pollution on ground-dwelling invertebrates. We investigated the effects of industrial heavy metal (Pb, Zn) contamination on ground-dwelling

ant and plant communities in the surrounding of Copșa Mică, a well known highly polluted area. We analyzed the effects of heavy metal pollution in terms of diversity, community structure and composition. Ants were sampled with pitfall traps, from 9 sites (6 meadows and 3 forests) alongside a pollution gradient, in one field campaign in July 2014. Plants were visually estimated applying the Braun-Blanquet cover classes using random quadrat plots. We identified only 15 ant species and 45 plant species, resulting in a relatively impoverished ecosystem. In the case of ants, we observed no pattern in terms of species number. However, plant species richness increased with distance from the pollution source, at least in the grassland sites. Based on the Equitability index ants recorded higher values in the first three and last three sites, where as in the middle sites of the gradient higher values were recorded for plants. Typical ant communities shape the habitats near Copșa Mică. Forest species such as *Myrmica ruginodis* Nylander 1846, *Temnothorax crassispinus* Karavaiev 1926, *Stenamma debile* Förster 1850 or *Lasius platythorax* Seifert, 1991 occurred in the forest sites, whereas *Lasius niger* Linnaeus 1758, *Formica cunicularia* Latreille 1798, *Formica rufibarbis* Fabricius 1793 or *Myrmica schenki* Viereck 1903, were identified in the meadow sites. Our preliminary results show that despite the intensive pollution in the past, ant and plant communities slowly recover, having different trajectories.

(14) Preliminary analysis of the *Lasius niger* larvae digestive tract

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It is known that *Lasius niger* are omnivorous ants. The diet consists of small invertebrates and liquid carbohydrates from plant's nectar and honeydew of aphids. Worker ants feed larvae by trophallaxis. However, we do not have detailed knowledge about digestion of food and its exchange

between larva and worker. In recently sequenced genome of *L. niger* genes, preliminary annotated as peritrophine genes, were found. It is a complex task finding out whether these genes are truly responsible for the synthesis of proteins of peritrophic membrane (PM). At the first stage, the aim of the analysis was to investigate the presence of peritrophic membrane in *L. niger* larvae of late instars. The study was conducted via histological method and using SEM. We made paraffin sections of larvae. Sections were stained by standard hematoxylin-eosinophil method. For SEM methods of research, lengthwise cleavages were made along the entire body of the larvae. Our study shows that one layer of large epithelial cells forms the midgut wall. The inner walls of the midgut has the layer of the villi, which touches PM. Histological samples and SEM images reveal the presence of the insect PM in late instars larvae of *L. niger*. PM is a multi-layered formation consisting from up to 15 layers. Multilayer PM surrounds the bolus of not digested solid food. Since midgut is blind, the PM acts as a filter for nutrients and stores food residues till the moment of pupation. We plan to study early instars larvae of this species further.

(15) Foraging in *Liometopum microcephalum* (Formicidae: Dolichoderinae): territories, activity dynamics and food items

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For a long time the pontomediterranean, arboricolous ant *Liometopum microcephalum* (Panzer, 1798) had been considered an exclusive predator. Today we know that trophobiosis presents an important part of its diet. Its importance compared to animal prey still has to be quantified. Very limited data have been published on the composition of food carried in the workers' mandibles. We present observations regarding the foraging behaviour of this species (additional to our published results on trophobiosis), including composition of items carried to the nest, response to baits according to seasonal and diurnal patterns and character of the bait (proteins vs sugars), and shapes and sizes of territories. We observed that territories were of irregular, often star-like shape, with trails leading from the nest tree to one or several "foraging trees". The space among these trails remained largely undefended, possibly unexplored. However, some trails leading away from nest trees branched and got lost in the forest undergrowth. Territory sizes changed in the course of the year (shrinking towards the summer) and between years: foraging trees were abandoned or visited anew, sometimes due to clashes with competitors. Daily foraging activity showed a minimum from late morning till noon or early afternoon. Interest in food baits decreased from April to July; protein-rich baits (tuna) were preferred against sugar-rich ones (honey). Whereas baits placed on nest tree trunks were readily visited, such presented on the ground were often ignored. Prey, however, included typical soil fauna such as earthworms. Pieces of leaves represented ca 20% of items carried in the workers' mandibles, also seeds and pieces of fungi were collected. Our results are still preliminary due to limited sample size and study area, but provide a more complete picture than hitherto available. The ecosystem effect of the large colonies, in particular on the invertebrate community, remains to be assessed.

(16) Ant (Hymenoptera: Formicidae) diversity and composition in a small scale forest-grassland ecotone

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An ecotone is a transitional zone between two or more different types of ecological communities. Insects are valuable ecological indicators of ecotones. Among insects, ants are considered terrestrial ecosystem engineers. We were particularly interested in the effects of ecotone on ant diversity and community composition. Three habitats were investigated: grassland, deciduous forest and the ecotone formed by the previous habitats, in Southern Transylvania (Romania). Pitfall traps were installed in three seasons (May, July and September) in 2012. One transect consisting of 15 pitfall traps was placed in each habitat. Altogether we identified 21 ant species belonging to 2 subfamilies. The highest richness (18 species) occurred in the ecotone whereas 8 ant species were identified in the grassland and forest habitats. As expected, the investigated habitats were significantly different in terms of species composition. Species richness and community composition varied significantly along the grassland-forest gradient, thus these three habitats were shaped by specific communities. The ecotone provided a characteristic ant fauna: *Camponotus ligniperdus*, *C. vagus*, *Formica fusca*, *F. pratensis*, *Myrmica schencki* and *Plagiolepis pygmaea*.

(17) The effect of social parasites on *Myrmica* colony productivity parameters

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Social parasitism is widespread phenomena among social insects. There are many ant species as well as a high number of other insect species, which have evolved as social parasites of ants. By definition, the impact of social parasites on host colony fitness is negative although the actual assessment of their effect is known only in a few cases. *Myrmica* ants host high number of social parasites, e.g. larvae of a few *Maculinea* species and larvae of a hoverfly, *Microdon myrmica*. Some *Myrmica* populations are parasitized by multiple parasite community and even a few social parasite species simultaneously exploit colonies of these ants. These social parasites use various feeding and growing strategies inside host colonies and such differences can result in differential effects on host fitness. The main aim of our study was to assess the fitness-related consequences of *Maculinea alcon*, *M. teleius* and *M. myrmicae* parasitism in *Myrmica* colonies in a population exposed to a multiple parasite community. We investigated various components of host colony and one of the most important was colony production-the number of new workers and sexual forms. In the end of social parasite larval development 45 *Myrmica scabrinodis* nests were excavated from the field and the number of adult workers, queens and brood were counted. In general, the presence of all social parasite species negatively affects the total production of infested *Myrmica* nests and strong negative effect was demonstrated for the gyne production. Among the studied parasite species the most negative influence was found for *M. teleius*, which feeds on the host brood of the biggest size, therefore it eliminates a high number of both sexual forms (gynes and males) and it also reduce the worker production.

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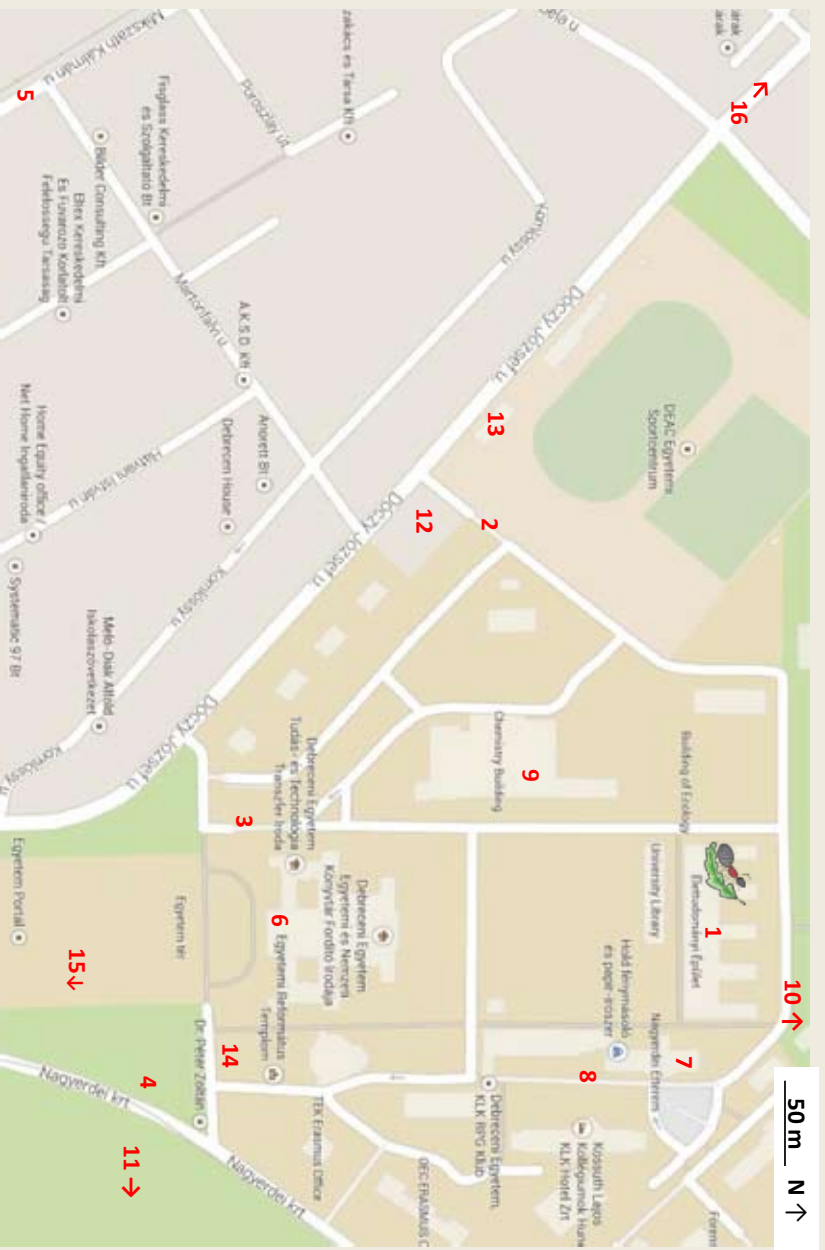
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- 1: Venue (Life Science Building: 47°33'21.31"N; 21°37'18.35"E); 2: Western gate of the campus; 3: Southern gate of the campus; 4: The nearest station (Egyetem) of Tram 1; 5: The nearest station (Károlyi Mihály utca) of Tram 2; 6: Main building; 7: Canteen (Nagyterei Restaurant); 8: Hostels; 9: The nearest Cash Machines (within the building: available at weekends only with luck); 10: Botanical Garden; 11: Nagyerdő (forest with spas, hotels, restaurants); 12: The nearest supermarket; 13: The nearest pub (Teniszke); 14: Street vendors; 15: City centre (3 km); 16: The nearest nonsport